

CHEMISTRY

Core Competencies FA2025-SP2026

Core Competency: Critical Thinking

Students will be able to examine, critique and synthesize information in order to arrive at reasoned conclusions.

Outcome Measure:

Results & Discussion score of their final Biochemistry Lab report

Criteria for Success (how do you judge if the students have met your standards):

80% of the students will score above 80% in the Results & Discussion section of their Biochemistry final lab report.

Aligned with DQP Learning Areas (circle one or more but not all five):

1. Specialized Knowledge
2. Broad Integrative Knowledge
3. Intellectual Skills/Core Competencies
4. Applied and Collaborative Learning, and
5. Civic and Global Learning

Longitudinal Data:

	2023- 24	2024- 25	2025- 26
Number of students	N/A	n= 11	n=20
<i>Percent scoring above 80% on their Results & Discussion Section</i>	Not assessed	90.9% ^b	100%

	<i>Percentage of Students Marginal or Proficient</i>							
	2016- 17	2017- 18	2018- 19	2019- 20	2020- 21	2021- 22	2022- 23	2023- 24
Number of students	n=25	n=17	n=20	n=35	n=26	n=28	n= 25	N/A
<i>ETS Proficiency Profile Level 2 Reading</i>	96.0%	88.2%	95.0%	74.3%	73.1%	89.3%	92%	Not assessed

Conclusions Drawn from Data:

This is our second time using the students' final lab report in biochemistry to assess Critical Thinking. In particular, we chose to use their Results & Discussion score, because this is where they are evaluating their experimental data to arrive at reasoned conclusions. Once again the students easily met the criteria for success.

Changes to be Made Based on Data:

No major changes this time. We will continue to collect data and see whether our new outcome measure and criteria for success are providing useful information.

Rubric Used:

Results and Discussion – 35 points

Here are your subheadings as you walk me through everything you have learned from this project (you can give them different titles).

Full credit requires the following:

- Activity analysis
 - Explain the assay itself – what does the information on the graph mean in terms of beta-gal function – 5 points
 - This should include a **figure of ONPG** with an explanation of how it works as a pseudo substrate.
 - **FIGURE:** graph of your WT and mutant activity plotted together on the same graph – 5 points
 - Describe what the Figures are telling us in the text of your results/discussion – 5 points
 - Are the results in your activity Figure expected or are these results surprising?
 - What does this specifically tell you (or begin to tell you) about the Beta-gal active site mechanism – 5 points
- Functional relevance of your results in the broader research community – 5 points
 - Find one additional paper using PubMed that is relevant to your work (site directed mutagenesis of Beta-Gal, studies of the active site, the use of beta-gal in the treatment of lactose intolerance, etc. – there are a lot of options here.
 - Include a short paragraph explaining how this study relates to your project or how your project could be modified to provide additional information to this type of study.
 - Reference this work in your references
- Future Directions: Where would you go from here? – 5 points
 - Propose one additional mutation to learn more detail or go more in depth as a way of enhancing what your mutation told you,
 - What would you propose and why?
- Overall editing – 5 points
 - Work is proofread for typos
 - References are correctly labeled and referenced within the text
 - Figures and captions have correct labels
 - Figures are all referenced within the text

CHEMISTRY Core Competencies

Core Competency: Written

Students will be able to effectively express ideas and information to others through written communication.

Outcome Measure:

Introduction score of their final Biochemistry Lab report

Criteria for Success (how do you judge if the students have met your standards):

80% of the students will score above 80% in the Introduction section of their Biochemistry final lab report.

Aligned with DQP Learning Areas (circle one or more but not all five):

1. Specialized Knowledge
2. Broad Integrative Knowledge
3. Intellectual Skills/Core Competencies
4. Applied and Collaborative Learning, and
5. Civic and Global Learning

Longitudinal Data:

	2023- 24	2024- 25	2025- 26
Number of students	N/A	n= 11	n=20
<i>Percent scoring above 80% on their Introduction Section</i>	Not assessed	100%	100%

	<i>Percentage of Students Marginal or Proficient</i>							2023- 24
	2016- 17	2017- 18	2018- 19	2019- 20	2020- 21	2021- 22	2022- 23	
Number of students	n=25	n=17	n=20	n=35	n=26	n=28	n= 25	N/A
<i>ETS Proficiency Profile Level 2 Writing</i>	88.9%	82.4%	90.0%	74.3%	80.8%	75.0%	64%	Not assessed

Conclusions Drawn from Data:

This is our second time using the students' final lab report in biochemistry to assess Writing. In particular, we chose to use their Introduction score, because students have multiple opportunities to revise and improve their writing in this section, and the ultimate product is graded entirely on the effectiveness of their prose. As shown above, all the students have again met the criteria for success.

Changes to be Made Based on Data:

We adjusted the rubrics used based on feedback from the Vice Provost for Educational Effectiveness. We will continue to collect data and see whether our new outcome measure and criteria for success are providing useful information.

Rubric Used

Rubric for the Introduction, total of 20 points:

Description of Biological Relevance (full credit – 3 points):

- Thorough explanation of the background of why it is interesting to study beta-gal and health implications – 3 points
- Brief explanation of the background of why it is interesting to study beta-gal and health implications – 2 points
- Missing why it is interesting or health implications – 1 point
- Missing introduction – 0 points

Active Site Mechanism (full credit – 3 points):

- Thorough and accurate explanation of the mechanism happening at the active site – 3 points
- Brief and accurate explanation of the mechanism happening at the active site – 2 points
- Some inaccuracies in the explanation – 1 point
- Inaccurate or missing – 0 points

Introduction of Mutation (full credit – 4 points)

- Explain the mutation and the aspect of the mechanism that this project seeks to learn – 4 points
- List the mutation, but minimal explanation for what this seeks to learn – 2 points
- Mutation listed, but no explanation for what this seeks to learn – 1 point
- Missing – 0 points

Figures are referenced in the text (full credit – 2 point)

- All figures are specifically referenced by its number in the text – 2 points
- Most, but not all, figures are referenced in the text – 1 point
- Figures are not referenced in the text – 0 points

Figure labels (full credit – 2 points)

- Figures are labeled in numerical order based on the order in the paper and the labels should be underneath the figure itself – 2 points
- Figures are labeled, but not in numerical order – 1 point
- Figures are labeled with labels above figures – 1 point
- Figures are not labeled – 0 points

Figure Captions (full credit – 3 points)

- Each figure should have a 1 - 2 sentence caption describing what the reader is seeing in the figure – 3 points
- Incomplete or minimal caption – 1 point
- No caption – 0 points

References (full credit – 3 points)

- There should be 3 references at the end of the manuscript, each used at least once in the text – 2 points
- 2 references – 2 points
- 1 reference – 1 point
- References present at the end, but not referenced in text – 1 point
- No references – 0 points

CHEMISTRY Core Competencies

Core Competency: Quantitative Reasoning

Students will be able to solve problems that are quantitative in nature.

Outcome Measure:

Score on their final Bomb Calorimetry report in Physical Chemistry.

Criteria for Success (how do you judge if the students have met your standards):

80% of the students will score above 80/100 on their report.

Aligned with DQP Learning Areas (circle one or more but not all five):

1. Specialized Knowledge
2. Broad Integrative Knowledge
3. Intellectual Skills/Core Competencies
4. Applied and Collaborative Learning, and
5. Civic and Global Learning

Longitudinal Data:

	2023- 24	2024- 25	2025- 26
Number of students	N/A	n=10	n=17
<i>Percent scoring above 80 on their bomb calorimetry report</i>	Not assessed	100.0%	94.1%

	<i>Percentage of Students Marginal or Proficient</i>							
	2016- 17	2017- 18	2018- 19	2019- 20	2020- 21	2021- 22	2022- 23	2023- 24
Number of students	n=25	n=17	n=20	n=35	n=26	n=28	n= 25	N/A
<i>ETS Proficiency Profile Level 2 Math</i>	100.0%	94.1%	95.0%	94.3%	88.5%	100.0%	96.0%	Not assessed

Conclusions Drawn from Data:

This is our second year using the students' Bomb Calorimetry Lab Report in Physical Chemistry. We chose this because it is a single assignment that features many of the chemistry-relevant quantitative skills in which students need to demonstrate proficiency (including plotting data in Excel, performing multiple linear regressions, unit conversions and algebraic rearrangements of thermodynamics equations, stoichiometry, and error analysis.) We can see that most students again met or exceeded the criterion for success that we chose.

Changes to be Made Based on Data:

We adjusted the rubrics used based on feedback from the Vice Provost for Educational Effectiveness. We will continue to collect data and see whether our new outcome measure and criteria for success are providing useful information.

Rubric Used:

Criterion	Points	Outstanding (full credit)	Good (partial credit)	Developing (no credit)	Unsatisfactory (no credit for the whole section)
Title	2	Title present and descriptive	Title insufficiently descriptive		Title not present
Methods: No unnecessary results	3	Methods do not include any results not needed to understand the procedure		Methods include unnecessary results	Methods are absent
Methods: Paragraphs	3	Methods are written in paragraph form	Methods are mostly in paragraph form, but include some sentence fragments or bullet points	Methods are written as bullet points	Methods are absent
Method: Narrative	3	Methods are entirely in past tense and indicative mood	Methods are mostly in past tense and indicative mood, but there are occasional instances of present tense and/or imperative mood	Methods are predominantly in present tense and/or imperative mood	Methods are absent
Method: Reproducible detail	3	Methods include sufficient detail for a reasonably experienced chemist to reproduce the procedure	A reasonably experienced chemist would need only a few additional details to reproduce the procedure	A reasonably experienced chemist could not reproduce the procedure as written	Methods are absent
Method: No excessive/unnc essary detail	3	No details are included that would be obviously necessary to a reasonably experienced chemist	A few extra details are included that would not be necessary for a reasonably experienced chemist	The procedure is written as if it needs to be followed by an inexperienced undergraduate student	Methods are absent

Method: All noteworthy hazards	3	All uncommon or specialized hazards are included	Most uncommon or specialized hazards are included, and any missing hazards are not of high risk of harm to people or equipment	Several uncommon or specialized hazards are omitted and/or any hazard presenting high risk of harm to people or equipment is omitted.	Methods are absent
Method: No common/obvious hazards	3	No hazards are included that are common to most chemical laboratory situations or would be obvious to a generally experienced chemist	Hazards are included that are not common to most chemical laboratory situations, but would still be obvious to a generally experienced chemist	Hazards are included that are common to most chemical laboratory situations	Methods are absent
R&D: All tables/figures appear near first mention (which logically prohibits results being separated from discussion)	3	All tables and figures appear near the first mention of the content in the natural flow of the discussion	At least one table or figure is mentioned earlier in the text than is supported by the flow of the discussion	Any table or figure is not close to the first mention of the content in the discussion	Results and Discussion are absent
R&D: All tables/figures cross-referenced in text	3	All tables and figures are cross-referenced in the text	Only one table or figure is missing a cross reference, unless that is the only table or figure in the document	Multiple tables or figures are not cross-referenced, or the only table or figure present is not cross-referenced	Results and Discussion are absent
R&D: All tables/figures have correct caption placement	2	There are captions directly above all tables and directly below all figures	Captions are directly above or below all tables or figures, but at least one is in the wrong place	At least one table or figure is missing a caption	Results and Discussion are absent
R&D: All tables/figures have descriptive captions	2	All table/figure captions are descriptive sentences	Any table/figure has a caption that is merely a basic title	Multiple tables or figures do not have descriptive captions.	Results and Discussion are absent
R&D: All tables/figures are numbered correctly	2	All tables are numbered sequentially starting from Table 1. All figures are numbered sequentially starting from Figure 1.	Tables and figures are numbered sequentially starting from 1, but not separately from each other	Tables and figures are not numbered sequentially from 1.	Results and Discussion are absent
R&D: All tables/figures have no excessive blank space	2	No table or figure has excessive blank space	Only one table or figure has excessive blank space, unless that is the only table or figure in the document	Multiple tables or figures have excessive blank space, or the only table or figure present has excessive blank space	Results and Discussion are absent

R&D: All graphs have accurate titles	2	All graphs have accurate titles	Any graph has an inaccurate title	Any graph is missing a title	Results and Discussion are absent
R&D: All graphs have axes correctly labeled	2	All graphs have axes labeled with correct units	Any graph axis does not have correct unit labeling	Any graph axis has any other error in labeling	Results and Discussion are absent
R&D: All graphs have correct y vs. x orientation ()	2	All graphs have the vertical axis as the dependent variable and the horizontal axis as the independent variable		Any graph has incorrect axes	Results and Discussion are absent
R&D: All tables/figures are fully legible	3	All text in all tables and figures is at least 10pt. There are no compression artifacts.	Any text in any table or figure is 8-9 pt	Any text in any table or figure is below 8pt OR there are visible compression artifacts (i.e., a table or figure is an image rather than a native MSOffice object)	Results and Discussion are absent
R&D: Paragraphs	3	Results and Discussion is written in paragraph form	Results and Discussion is mostly in paragraph form, but include some sentence fragments or bullet points	Results and Discussion are written as bullet points	Results and Discussion are absent
R&D: No excess data	3	No data is included beyond what is indicated in the instructions, OR any such data meaningfully contributes to the narrative	Data is included beyond that which is indicated in the instructions and such data contributes only tangentially to the narrative	Data is included beyond that which is indicated in the instructions that does not contribute to the narrative	Results and Discussion are absent
Result: Temp vs. time plot	2	Present		Not present	Results and Discussion are absent
Result: Calorimeter constant	2	Present		Not present	Results and Discussion are absent
Result: Experimental $\Delta H_{r,m}$ (naphthalene) in kJ/mol	3	Present in correct units	Present in other units	Not present	Results and Discussion are absent

Result: Computational $\Delta H_{r,m}$ (naphthalene) in kJ/mol	3	Present in correct units	Present in other units	Not present	Results and Discussion are absent
Result: $\Delta H_{r,m}$ (naphthalene), both values compared to lit	2	Present		Not present	Results and Discussion are absent
Result: $\Delta H_{r,m}$ (foodstuff) in kcal/g	3	Present in correct units	Present in other units	Not present	Results and Discussion are absent
Result: $\Delta H_{r,m}$ (foodstuff) comparison to label	2	Present		Not present	Results and Discussion are absent
Error: Parr manual error sources	3	Discussion includes the sources of error discussed in the Parr manual	Discussion of error is superficial	Not present	Error analysis is absent
Error: Pressure changes	3	Error due to pressure changes is discussed	Discussion of error is superficial	Not present	Error analysis is absent
Error: Additional errors considered	3	Error sources not already specified in the instructions are discussed	Discussion of error is superficial, yet still specific	Not present, or vague statements are included such as "human error" or "error is always a possibility"	Error analysis is absent
Error: Integrated into discussion	3	Error discussion is embedded throughout the Results and Discussion section	Most error discussion is concentrated in one place, but occasional mention of error is elsewhere in the discussion	Error discussion is effectively a distinct subsection of the Results and Discussion with no integration	Error analysis is absent
References: All references ACS style	2	All references are in the specified form of ACS citation style	Most references are in ACS style, but a few have minor deviations	References are not in ACS style	References are absent
References: Superscript numbers	3	All in-text citations are superscript numbers in increasing order of citation	All in-text citations are superscript numbers but not in increasing order of citation	Any in-text citations are not superscript numbers	References are absent

References: Literature values	3	All reference values have citations from reliable scholarly sources	Reference values include citations from reliable but non-scholarly sources, or from unreliable sources that have the appearance of being scholarly	Reference values are not cited or have blatantly inadequate sources	References are absent
References: Procedure	3	Methods section cites the experiment instructions handout		Methods section does not cite the experiment instructions handout	References are absent
References: Nothing left uncited	3	Anything that did not originate from the student or their group has a citation.		Anything that should have had a citation does not have one.	References are absent
Reflection	5	Any thoughtful response	Response is superficial.		Reflection is absent

CHEMISTRY
Core Competencies

Core Competency: Oral Communication

Students will develop oral communication skills.

Outcome Measure: Chemistry Research Study Presentation in Chemistry Seminar (CHE4095).

Criteria for Success: At least 80% of students will have an average score of 3 or higher.

Longitudinal Data:

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
	n=18	n=13	n=11	n=18	n=14	n=15	n=18	n=17	n=13	n=12
% students with average score of 3.0 or higher in Chemistry Research Study Presentation	100%	100%	100%	100%	92.9%	93.3%	88.9%	100%	100%	100%

Conclusions Drawn from Data: The criteria for success were met in all years 2015 – 2026, therefore we conclude that students are successful in oral communication. We believe this can be attributed to several factors including an increased number of oral presentations required in upper division courses and students' involvement in our summer research where they present their project to each other on a weekly basis.

Changes to be Made Based on Data: No changes are necessary.

Rubric Used: See rubric a few pages below.

CHEMISTRY Core Competencies

Core Competency: Information Literacy

Students will develop information literacy skills.

Outcome Measure: Chemistry Research Study Presentation in Chemistry Seminar (CHE4095)

Criteria for Success (if applicable): At least 80% of students will have an average score of 3 or higher.

Longitudinal Data:

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
	n=18	n=13	n=11	n=18	n=14	n=15	n=18	n=17	n=13	n=12
<i>% Students with average score of 3.0 or higher in Chemistry Research Study Presentation</i>	100%	84.6%	100%	94.4%	100%	100%	94.4%	100%	100%	100%

Conclusions Drawn from Data: The criteria for success were met in all years 2015 – 2026, therefore, we conclude that students are successful in information literacy.

Changes to be Made Based on Data No changes are necessary as our students clearly learn to develop skills over their 4 years at PLNU.

Rubric Used: See below.

CHE 4095 rubrics (**Oral Communication** and **Information Literacy**)

	Outstanding	High satisfactory	Low satisfactory	unsatisfactory
Command of background material	- Clearly knows material and key facts by memory - Expands on PPT slides - Content and language appropriate for audience	- Clearly knows key facts with a few memory slips - Some expansion on PPT slides - Partial audience adaptation of content	- Read some information; knows some facts from memory - No expansion on PPT slide content - little audience adaptation of content	- Read sentence from slides - Dependent on notes - Lack audience adaptation of content
Organization	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently observable and is skillful and makes the content of the presentation cohesive.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently observable within the presentation	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is intermittently observable within the presentation.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is not observable within the presentation.
Delivery	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation compelling, and speaker appears polished and confident.	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation interesting, and speaker appears comfortable.	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation understandable, and speaker appears tentative.	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) detract from the understandability of the presentation, and speaker appears uncomfortable.

Use Information Effectively to Accomplish a specific purpose	Communicates, organizes and synthesizes information from sources to fully achieve a specific purpose, with clarity and depth	Communicates, organizes and synthesizes information from sources. Intended purpose is achieved.	Communicates and organizes information from sources. The information is not yet synthesized, so the intended purpose is not fully achieved.	Communicates information from sources. The information is fragmented and/or used inappropriately (misquoted, taken out of context, or incorrectly paraphrased, etc.), so the intended purpose is not achieved.
Determine the Extent of Information	Effectively defines the scope of the research question or thesis. Effectively determines key concepts. Types of information (sources) selected directly relate to concepts or answer research question.	Defines the scope of the research question or thesis completely. Can determine key concepts. Types of information (sources) selected relate to concepts or answer research question.	Defines the scope of the research question or thesis incompletely (parts are missing, remains too broad or too narrow, etc.). Can determine key concepts. Types of information (sources) selected partially relate to concepts or answer research question.	Has difficulty defining the scope of the research question or thesis. Has difficulty determining key concepts. Types of information (sources) selected do not relate to concepts or answer research question.